PATENT ABSTRACTS OF JAPAN

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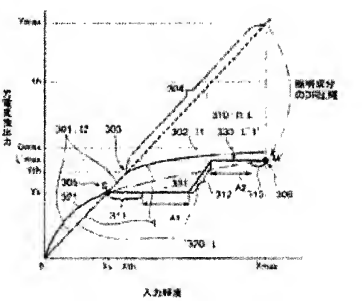
SATO KAZUMUTSU

(54) IMAGING APPARATUS AND IMAGE PROCESSING METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To increase lightness difference of an illumination component at a required part of an image, in dodging processing.
SOLUTION: An imaging means images an object light; an illumination component extracting means extracts an illumination component from a photographed image by the imaging means; a reflectance component extract means extracts reflectance component from the photographed image; a compression characteristic setting means sets at least two prescribed regions, with respect to the photographed image, sets a compression characteristics for emphasizing the lightness difference between the regions; a compression means compresses the dynamic range of the illumination component, on the basis of the compression characteristics set by the compression characteristics setting means; and an image generating means generates a new image, on the basis of the compressed illumination component whose dynamic range has been compressed and of the reflectance component.



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CLAIMS

[Claim(s)]
[Claim 1]
An imaging means which picturizes object light,
A Lighting Sub-Division component extraction means to extract the Lighting Sub-Division ingredient from a taken image by said imaging means,
A reflectance component extraction means to extract a reflectance ingredient from said taken image,
A compression means which compresses a dynamic range of the Lighting Sub-Division ingredient extracted by said Lighting Sub-Division component extraction means based on the predetermined compression characteristic,
A picture generation means which generates a new picture from a compression Lighting Sub-Division ingredient for which said compression means comes to compress a dynamic range of the Lighting Sub-Division ingredient, and a reflectance ingredient extracted by said reflectance component extraction means,
While setting up at least two predetermined fields to said taken image or said Lighting Sub-Division ingredient, it has a compression characteristic setting-out means to set up said compression characteristic of emphasizing lightness difference between each field concerned,
An imaging device, wherein said compression means compresses a dynamic range of said Lighting Sub-Division ingredient based on the compression characteristic set up by said compression characteristic setting-out means.
[Claim 2]
The imaging device according to claim 1, wherein said compression characteristic setting-out means sets up the compression characteristic which inclination is zero and changes into the state where it was made to estrange by a predetermined compression amount mutually a portion corresponding to said each field of a characteristic line which shows the compression characteristic.
[Claim 3]
It has further a histogram preparing means which creates a luminance histogram of said taken image or the Lighting Sub-Division ingredient,
The imaging device according to claim 1 or 2, wherein said compression characteristic setting-out means sets up a prescribed range on luminosity in a luminance histogram as said each field.
[Claim 4]
The imaging device according to any one of claims 1 to 3, wherein said compression characteristic setting-out means sets up said each field based on a picture of this prescribed range while setting up a spatial prescribed range in said taken image or said Lighting Sub-Division ingredient.
[Claim 5]
The imaging device according to claim 3 or 4 said compression characteristic setting-out means' computing a peak of said luminance histogram, and setting up a prescribed range consisting mainly of this peak or a peak near position as said each field.
[Claim 6]

A 1st level value setting-out means against said Lighting Sub-Division ingredient to set up the 1st level value more than main object luminosity which shows a predetermined luminance value of a main object,

It has further a 2nd level value setting-out means against said Lighting Sub-Division ingredient to set up the 2nd level value below the predetermined generating picture maximum according to reflectance in a high luminance region of said reflectance ingredient,
The imaging device according to any one of claims 1 to 5 setting up the compression characteristic which said compression characteristic setting-out means uses a predetermined region by the side of low-intensity [of said each field] as said 1st level value and the level, and uses a predetermined region by the side of high-intensity as said 2nd level value and the level.
[Claim 7]
The 1st process of picturizing object light by an imaging means,
The 2nd process of extracting the Lighting Sub-Division ingredient from a taken image by said imaging means by the Lighting Sub-Division component extraction means,
The 3rd process of extracting a reflectance ingredient from said taken image by a reflectance component extraction means,
The 4th process of compressing a dynamic range of the Lighting Sub-Division ingredient extracted by said Lighting Sub-Division component extraction means based on the predetermined compression characteristic by a compression means,
The 5th process of generating a new picture by a picture generation means from a compression Lighting Sub-Division ingredient for which said compression means comes to compress a dynamic range of the Lighting Sub-Division ingredient, and a reflectance ingredient extracted by said reflectance component extraction means,
While setting up at least two predetermined fields to said taken image or said Lighting Sub-Division ingredient, it has the 6th process of setting up said compression characteristic of emphasizing lightness difference between each field concerned, by a compression characteristic setting-out means,
An image processing method, wherein said 4th process is a process of compressing a dynamic range of said Lighting Sub-Division ingredient by a compression means based on the compression characteristic set up by said compression characteristic setting-out means.
[Claim 8]
The image processing method according to claim 7, wherein said 6th process is a process of setting up the compression characteristic which inclination is zero and changes a portion corresponding to said each field of a characteristic line which shows the compression characteristic into the state where it was made to estrange by a predetermined compression amount mutually, by a compression characteristic setting-out means.
[Claim 9]
It has further the 7th process of creating a luminance histogram of said taken image or the Lighting Sub-Division ingredient by a histogram preparing means,
The image processing method according to claim 7 or 8, wherein said 6th process is a process of setting up a prescribed range on luminosity in a luminance histogram as said each field by a compression characteristic setting-out means.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Field of the Invention]
[0001]
This invention relates to the image processing method which may be applied to imaging devices, such as a digital camera, the imaging device which has a dynamic-range-compression function especially, and this.
[Background of the Invention]
[0002]
In recent years, in imaging devices, such as a digital camera, it is one big theme to make the luminance range of the photographic subject which an image pick-up sensor can treat, i.e., a dynamic range, (DR) expand with the request of high-definition-izing. By using the subthreshold level characteristic of MOSFET, concerning expansion of a dynamic range. The image pick-up sensor (it is called a linear log sensor) which has a photoelectric transfer characteristic which consists of an image pick-up sensor which has the characteristic that an electrical signal is changed in logarithm according to incident light quantity in the output characteristics by the side of high-intensity, i.e., a linear-characteristics field, and a logarithmic characteristic area is known. Since the output from which the linear log sensor was changed in natural logarithm to incident light quantity as mentioned above is obtained, a larger dynamic range is secured compared with the image pick-up sensor which has the photoelectric transfer characteristic of only a linear-characteristics field.
[0003]
While extensive dynamic range-ization of an imaging system progresses like the above-mentioned linear log sensor, even if extensive dynamic range-ization of the display system of a monitor etc. does not progress like an imaging system under the present circumstances but extensive dynamic range-ization of an inputted image is attained, In a display system, the effect can fully be demonstrated. Therefore, it is necessary to make the dynamic range of this inputted image compress so that the inputted image of an extensive dynamic range is settled in the dynamic range of a display system.
[0004]
By the way, for "compression of a dynamic range." The meaning which raises contrast (gradation) by adjusting the light and darkness of a picture locally, namely, compressing the Lighting Sub-Division ingredient of a picture, and where the relation of the light and darkness of the whole picture is maintained as it was, Although there are two meanings with the meaning (a picture is uniformly compressed regardless of local light-and-darkness adjustment) which compresses a zone (dynamic range) literally, the former shall be called "color dodge processing" and the latter shall be called "DR compression" in order to distinguish these.
[0005]
the above from the Lighting Sub-Division ingredient concerned by which DR compression was carried out after extracting the Lighting Sub-Division ingredient, for example from a picture (a reflectance ingredient is also extracted at this time) and carrying out DR compression of this Lighting Sub-Division

ingredient by color dodge processing conventionally, and a reflectance ingredient -- the new picture to which the light and darkness of the picture were adjusted locally is generated. With the art currently indicated by the patent documents 1, concerning this. These pictures are combined, after carrying out division extraction of the picture (it is henceforth called linearity / logarithmic picture) which has the photoelectric transfer characteristic of the linear characteristics and the logarithmic characteristic which were obtained by the linear log sensor at the log picture I1 and the linear picture I2 and performing color dodge processing by each picture, as shown in drawing 12. If this image composing is made into picture I' shown in drawing 13, DR compression to the source image I as an inputted image, i.e., above-mentioned linearity / logarithmic picture, will be performed so that this picture I' may be settled in the dynamic range of an outputted image (for example, the above-mentioned display system).
[Patent documents 1] Patent Application No. 2004-377875
[Description of the Invention]
[Problem(s) to be Solved by the Invention]
[0006]
However, in the art shown in the above-mentioned patent documents 1. By color dodge processing which is going to raise the contrast of the portion of the building 141 of a picture as the shade difference of the Lighting Sub-Division ingredient is shortened, namely, it is shown, for example in drawing 14, since the total luminance level of the Lighting Sub-Division ingredient is compressed uniformly. For example, the lightness difference of the empty 142 and the portion of the clouds 143 will become small (the empty 142 and the cloud 143 whole serving as what is called a picture that white-flew), and it will be a thin picture what is called with little contrast to which the contrast in the whole picture fell (picture). this -- drawing 15 -- being shown -- as -- being certain -- a picture -- ******** -- for example, -- about -- two -- twice -- luminance difference (difference D1 of the pixel value assumed) -- having -- luminosity -- A -- B (photographic subjects A and B) -- having seen -- a case -- Lighting Sub-Division -- an ingredient -- compression -- this -- luminosity -- A -- B -- it can set -- a pixel value -- A -- ' -- B -- ' -- a difference -- D -- two -- small -- becoming -- things -- depending .
[0007]
In light of the above-mentioned circumstances in color dodge processing, an object of this invention is to provide the imaging device and image processing method which can acquire the natural picture which could enlarge lightness difference of the Lighting Sub-Division ingredient in the necessary field of a picture, and was effective by extension.
[Means for Solving the Problem]
[0008]
An imaging means in which an imaging device concerning Claim 1 of this invention picturizes object light, A Lighting Sub-Division component extraction means to extract the Lighting Sub-Division ingredient from a taken image by said imaging means, A reflectance component extraction means to extract a reflectance ingredient from said taken image, and a compression means which compresses a dynamic range of the Lighting Sub-Division ingredient extracted by said Lighting Sub-Division component extraction means based on the predetermined compression characteristic, A picture generation means which generates a new picture from a compression Lighting Sub-Division ingredient for which said compression means comes to compress a dynamic range of the Lighting Sub-Division ingredient, and a reflectance ingredient extracted by said reflectance component extraction means, While setting up at least two predetermined fields to said taken image or said Lighting Sub-Division ingredient, Having a compression characteristic setting-out means to set up said compression characteristic of emphasizing lightness difference between each field concerned, said compression means compresses a dynamic range of said Lighting Sub-Division ingredient based on the compression characteristic set up by said compression characteristic setting-out means.
[0009]
According to the above-mentioned composition, object light is picturized by imaging means and the Lighting Sub-Division ingredient is extracted from a taken image by an imaging means by the Lighting Sub-Division component extraction means, While a reflectance ingredient is extracted from a taken

image by reflectance component extraction means and at least two predetermined fields to a taken image or the Lighting Sub-Division ingredient are set up by a compression characteristic setting-out means, the compression characteristic of emphasizing lightness difference between each field concerned is set up. And a new picture is generated from a compression Lighting Sub-Division ingredient and a reflectance ingredient into which a dynamic range of the Lighting Sub-Division ingredient extracted [above-mentioned] by compression means based on the compression characteristic set up by a compression characteristic setting-out means was compressed into, and this dynamic range was compressed by picture generation means.

[0010]

An imaging device concerning Claim 2 sets up the compression characteristic changed into the state where said compression characteristic setting-out means made portion of each other [inclination is zero and] corresponding to said each field of a characteristic line which shows the compression characteristic estrange by a predetermined compression amount in Claim 1. According to this composition, the compression characteristic which inclination is zero and changes a portion corresponding to each field concerned of a characteristic line which shows the compression characteristic into the state where it was made to estrange by a predetermined compression amount mutually, by a compression characteristic setting-out means is set up.

[0011]

An imaging device concerning Claim 3 is further provided with a histogram preparing means which creates a luminance histogram of said taken image or the Lighting Sub-Division ingredient in Claim 1 or 2, and said compression characteristic setting-out means sets up a prescribed range on luminosity in a luminance histogram as said each field. According to this composition, a luminance histogram of a taken image or the Lighting Sub-Division ingredient is created by histogram preparing means, and a prescribed range on luminosity in a luminance histogram is set up as each field by a compression characteristic setting-out means.

[0012]

As for an imaging device concerning Claim 4, in either of the Claims 1-3, said compression characteristic setting-out means sets up said each field based on a picture of this prescribed range while setting up a spatial prescribed range in said taken image or said Lighting Sub-Division ingredient. According to this composition, by a compression characteristic setting-out means, while a spatial prescribed range in a taken image or the Lighting Sub-Division ingredient is set up, each field is set up based on a picture of this prescribed range.

[0013]

In Claim 3 or 4, said compression characteristic setting-out means computes a peak of said luminance histogram, and an imaging device concerning Claim 5 sets up a prescribed range consisting mainly of this peak or a peak near position as said each field. According to this composition, by a compression characteristic setting-out means, a peak of a luminance histogram is computed and a prescribed range consisting mainly of this peak or a peak near position is set up as each field.

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TECHNICAL FIELD

[Field of the Invention]
[0001]
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PRIOR ART

[Background of the Invention]
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[0003]
While extensive dynamic range-ization of an imaging system progresses like the above-mentioned linear log sensor, even if extensive dynamic range-ization of the display system of a monitor etc. does not progress like an imaging system under the present circumstances but extensive dynamic range-ization of an inputted image is attained, In a display system, the effect can fully be demonstrated. Therefore, it is necessary to make the dynamic range of this inputted image compress so that the inputted image of an extensive dynamic range is settled in the dynamic range of a display system.
[0004]
By the way, for "compression of a dynamic range." The meaning which raises contrast (gradation) by adjusting the light and darkness of a picture locally, namely, compressing the Lighting Sub-Division ingredient of a picture, and where the relation of the light and darkness of the whole picture is maintained as it was, Although there are two meanings with the meaning (a picture is uniformly compressed regardless of local light-and-darkness adjustment) which compresses a zone (dynamic range) literally, the former shall be called "color dodge processing" and the latter shall be called "DR compression" in order to distinguish these.
[0005]
the above from the Lighting Sub-Division ingredient concerned by which DR compression was carried out after extracting the Lighting Sub-Division ingredient, for example from a picture (a reflectance ingredient is also extracted at this time) and carrying out DR compression of this Lighting Sub-Division ingredient by color dodge processing conventionally, and a reflectance ingredient -- the new picture to which the light and darkness of the picture were adjusted locally is generated. With the art currently indicated by the patent documents 1, concerning this. These pictures are combined, after carrying out division extraction of the picture (it is henceforth called linearity / logarithmic picture) which has the photoelectric transfer characteristic of the linear characteristics and the logarithmic characteristic which were obtained by the linear log sensor at the log picture I1 and the linear picture I2 and performing color

dodge processing by each picture, as shown in drawing 12. If this image composing is made into picture I' shown in drawing 13, DR compression to the source image I as an inputted image, i.e., above-mentioned linearity / logarithmic picture, will be performed so that this picture I' may be settled in the dynamic range of an outputted image (for example, the above-mentioned display system).
[Patent documents 1] Patent Application No. 2004-377875

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EFFECT OF THE INVENTION

[Effect of the Invention]
[0019]
Since according to the imaging device concerning Claim 1 the compression characteristic of emphasizing the lightness difference between at least two predetermined regions set up to the taken image or the Lighting Sub-Division ingredient is set up and the dynamic range of the Lighting Sub-Division ingredient is compressed based on this compression characteristic, In color dodge processing, the natural picture which could enlarge lightness difference of the Lighting Sub-Division ingredient in the necessary field of a picture, and was effective by extension can be acquired.
[0020]
Since the compression characteristic is set up by the method of changing into the state where made inclination to each field into zero, and it was made to estrange by a predetermined compression amount mutually according to the imaging device concerning Claim 2, the compression characteristic that the lightness difference between predetermined regions is emphasized can be obtained easily.
[0021]
Since the prescribed range on the luminosity in a luminance histogram is set up as each field according to the imaging device concerning Claim 3, when processing a picture, each field concerned can be easily set up using the luminance histogram generally created.
[0022]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]
[0006]
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[0007]
In light of the above-mentioned circumstances in color dodge processing, an object of this invention is to provide the imaging device and image processing method which can acquire the natural picture which could enlarge lightness difference of the Lighting Sub-Division ingredient in the necessary field of a picture, and was effective by extension.

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MEANS

[Means for Solving the Problem]
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[0009]
According to the above-mentioned composition, object light is picturized by imaging means and the Lighting Sub-Division ingredient is extracted from a taken image by an imaging means by the Lighting Sub-Division component extraction means, While a reflectance ingredient is extracted from a taken image by reflectance component extraction means and at least two predetermined fields to a taken image or the Lighting Sub-Division ingredient are set up by a compression characteristic setting-out means, the compression characteristic of emphasizing lightness difference between each field concerned is set up. And a new picture is generated from a compression Lighting Sub-Division ingredient and a reflectance ingredient into which a dynamic range of the Lighting Sub-Division ingredient extracted [above-mentioned] by compression means based on the compression characteristic set up by a compression characteristic setting-out means was compressed into, and this dynamic range was compressed by picture generation means.
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An imaging device concerning Claim 2 sets up the compression characteristic changed into the state where said compression characteristic setting-out means made portion of each other [inclination is zero and] corresponding to said each field of a characteristic line which shows the compression characteristic estrange by a predetermined compression amount in Claim 1. According to this composition, the compression characteristic which inclination is zero and changes a portion corresponding to each field concerned of a characteristic line which shows the compression characteristic into the state where it was made to estrange by a predetermined compression amount mutually, by a compression characteristic setting-out means is set up.
[0011]

An imaging device concerning Claim 3 is further provided with a histogram preparing means which creates a luminance histogram of said taken image or the Lighting Sub-Division ingredient in Claim 1 or 2, and said compression characteristic setting-out means sets up a prescribed range on luminosity in a luminance histogram as said each field. According to this composition, a luminance histogram of a taken image or the Lighting Sub-Division ingredient is created by histogram preparing means, and a prescribed range on luminosity in a luminance histogram is set up as each field by a compression characteristic setting-out means.

[0012]

As for an imaging device concerning Claim 4, in either of the Claims 1-3, said compression characteristic setting-out means sets up said each field based on a picture of this prescribed range while setting up a spatial prescribed range in said taken image or said Lighting Sub-Division ingredient. According to this composition, by a compression characteristic setting-out means, while a spatial prescribed range in a taken image or the Lighting Sub-Division ingredient is set up, each field is set up based on a picture of this prescribed range.

[0013]

In Claim 3 or 4, said compression characteristic setting-out means computes a peak of said luminance histogram, and an imaging device concerning Claim 5 sets up a prescribed range consisting mainly of this peak or a peak near position as said each field. According to this composition, by a compression characteristic setting-out means, a peak of a luminance histogram is computed and a prescribed range consisting mainly of this peak or a peak near position is set up as each field.

[0014]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[0083]
[Drawing 1]It is a digital camera which is an example of the imaging device concerning this embodiment, and is a rough block lineblock diagram concerning image pick-up processing to the Lord of this digital camera.
[Drawing 2]It is a functional block diagram for explaining each function of the image processing portion of the above-mentioned digital camera.
[Drawing 3]They are the graph charts for explaining the color dodge processing (situation of compression of the Lighting Sub-Division ingredient) by gray-scale-conversion processing of a described image treating part.
[Drawing 4]They are the graph charts for explaining creation of the histogram from a taken image, and setting out of photographic subject luminosity area based on a histogram.
[Drawing 5]It is a mimetic diagram for explaining the situation of change of the lightness difference of each part of a taken image by the color dodge processing by the above-mentioned digital camera.
[Drawing 6]It is a flow chart which shows an example of the operation about the color dodge processing by the digital camera in this embodiment.
[Drawing 7]It is a flow chart which shows an example of more detailed operation of DR compression processing in Step S5 shown in drawing 6.
[Drawing 8]It is a mimetic diagram showing the state of division of the imaging region for matrix metering (photometry range).
[Drawing 9]They are the graph charts for explaining the modification mode about setting out of photographic subject luminosity area.
[Drawing 10]They are the graph charts for explaining the modification mode about setting out of photographic subject luminosity area.
[Drawing 11]They are the graph charts for explaining the modification mode about setting out of photographic subject luminosity area.
[Drawing 12]They are the graph charts for explaining the conventional color dodge processing.
[Drawing 13]They are the graph charts for explaining the conventional color dodge processing.
[Drawing 14]It is a mimetic diagram showing the situation of change of the lightness difference of each part of a taken image in the conventional color dodge processing.
[Drawing 15]They are graph charts showing the situation of compression of the Lighting Sub-Division ingredient in the conventional color dodge processing.

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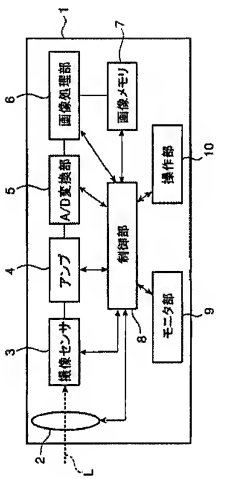
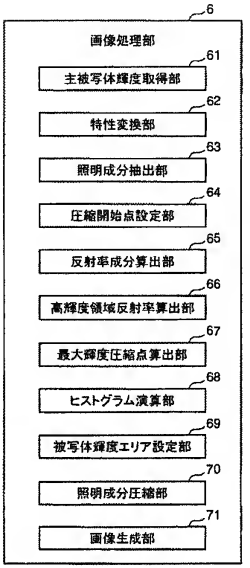
DRAWINGS

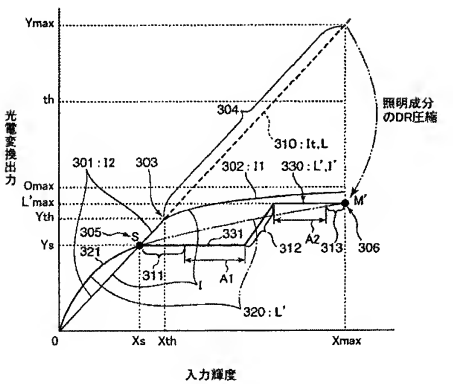
[Drawing 1]



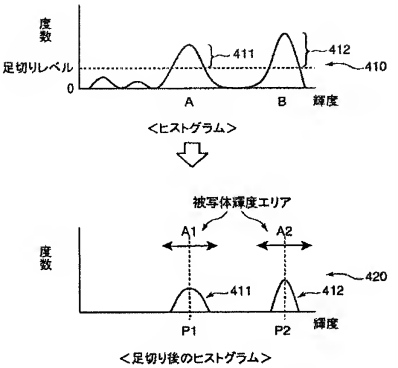
[Drawing 2]



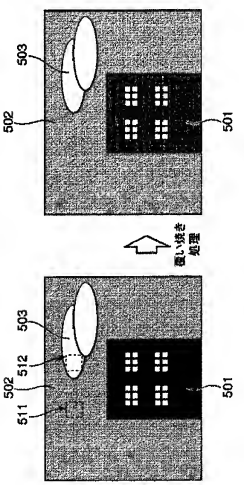
[Drawing 3]



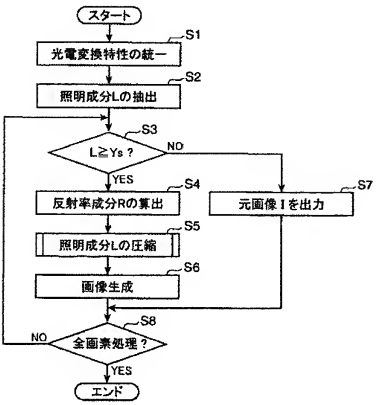
[Drawing 4]



[Drawing 5]



[Drawing 6]



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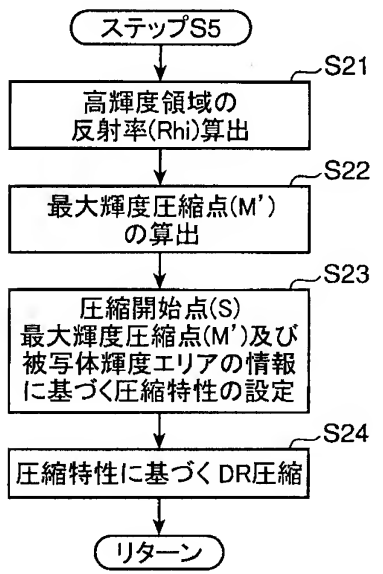
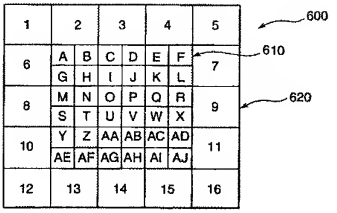
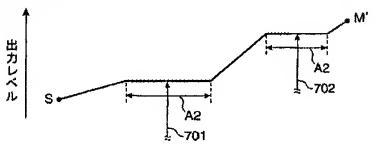


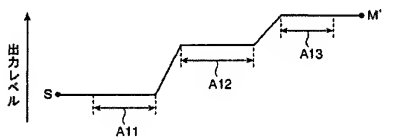
[Drawing 8]



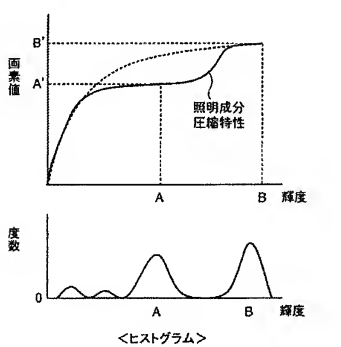
[Drawing 9]



[Drawing 10]

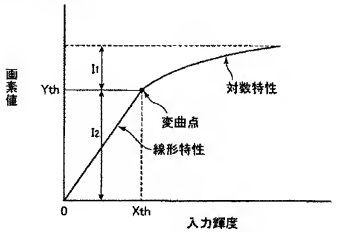


[Drawing 11]

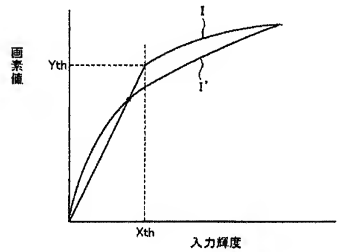


<ヒストグラム>

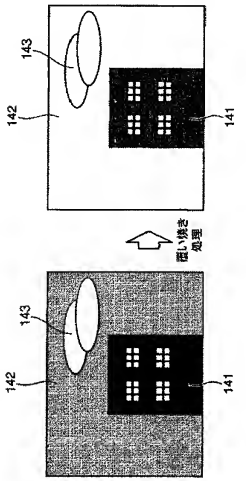
[Drawing 12]



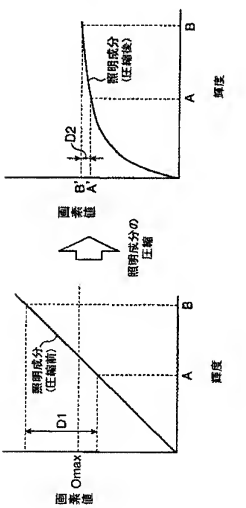
[Drawing 13]



[Drawing 14]


143
142
141
暗い領域処理
143
142
141

[Drawing 15]


B
照明成分(圧縮後)
A
D2
B'
A'
輝度
画素値
照明成分の圧縮
B
照明成分(圧縮前)
A
D1
輝度
画素値
Omax

[Translation done.]